Chapter Three
Review of Research on Supplemental Instruction

Introduction

Supplemental Instruction (SI) targets *high-risk courses* rather than high-risk students. At many campuses high-risk courses are typically defined as difficult, entry-level courses in which the unsuccessful enrollment rate (the percent of final grades of D, F, and withdrawals) is more than 30%. Examples of such courses at the University of Missouri-Kansas City include General Chemistry I, Western Civilization I, and Foundations of Philosophy. As new SI programs are developed, they often place an emphasis on entry-level courses. Therefore SI has served primarily first-year and sophomore students. However, the program has also been effectively implemented in courses where students are likely to fail at the graduate and professional school level (e.g., medicine, dentistry, pharmacy, business, and law) both at UMKC and other post-secondary institutions.

The primary purpose of SI is to assure that a course is no longer "high-risk" for students. However, even when the D, F, and withdrawal rates have been reduced, SI should not be discontinued. Data show that if SI is discontinued, the rates of Ds, Fs, and withdrawals return to the original baseline. The only condition under which SI should be discontinued is when a change in the course itself results in uniformly higher grades and, subsequently, lower levels of student participation in SI. Institutions that implement SI measure its impact through analysis of comparative data for students who participate in SI and those who do not.

The definition of a "high-risk" course relates to a single factor: the percent of students who complete the course successfully. For our own purposes, we consider it irrelevant whether the high rate of poor grades and/or withdrawals is a function of the course content, the instructional method, the hour the course is offered, or the population to whom it is offered. What we consider important is that students have academic difficulty.

We make no claim that SI addresses every need. Our goal is not to evaluate the curriculum or the instructional delivery of the professor, but rather to help the enrolled students perform satisfactorily in traditionally difficult courses. Other institutions, however, sometimes have other concerns (e.g., curriculum reform, improved instruction). Some institutions have addressed these issues with the introduction of SI.

There is substantial evidence that attrition follows poor grades. Students tend not to withdraw from courses or drop out of college when grades are acceptably high. Recent research (Schreiner, 1990) has suggested a strong correlation between grade point averages and persistence in college (Table 1).

Table 1
Dropouts and Persisters by College Grade Point Average (N = 3,874)

Grade Point Average Range	Dropouts (n = 1,060)	Persisters (n = 2,814)
GPA Below 2.00	42.1% (n = 336)	15.8% (n = 445)
GPA 2.00 to 2.49	18.9% (n = 200)	24.9% (n = 701)
GPA 2.50 to 2.99	19.6% (n = 208)	26.2% (n = 737)
GPA 3.00 to 4.00	19.1% (n = 206)	33.1% (n = 931)

Schreiner, L. A. (1990). The College Student Inventory: Accurately identifying students at risk. Iowa City: National Center for Student Retention.

SI is designed to increase student academic performance and has an indirect positive effect on student retention and ultimate graduation.

The effectiveness of Supplemental Instruction in producing positive changes in participants' academic performance has been documented by ongoing research conducted since 1981 by the University of Missouri-Kansas City as well as research from other Institutions participating in SI. This chapter reviews the methodology and results of these various research efforts.

Research Methodology

Research Design

The basic design of the various quasi-experimental research studies conducted since 1981 compared performance of the treatment groups (voluntary SI participants) with the control groups (non-SI participants). Additional analyses compared participants and non-participants in terms of their motivation to participate, their prior academic achievement, and their ethnicity. Dependent variables included final course grades, re-enrollment, and graduation rates. The research does not meet the standards for a true experimental design, but results have been replicated across many institutions.

Population

The population studied includes all students enrolled in courses in which SI was offered, whether or not the students participated in SI. For some analyses, the population represents only students from UMKC; other analyses include students from all institutions in the United States where SI has been adopted and effective data collection efforts have been made.

Instruments and Procedures

Course rosters and background data (e.g., ethnicity, standardized entrance test scores, high school rank) for students enrolled in SI targeted courses were obtained. A student survey was administered the first day of the course to determine the motivation level of the students with respect to SI. A second survey was administered the last day of the course to gain information from SI participants (e.g., evaluation of the SI program) and non-SI participants (e.g., reason for not attending SI). Faculty members in the targeted courses provided a list of students and their grades on the first major examination in the course. Final course grades, re-enrollment and graduation data for students were also obtained after the semester for students enrolled in the targeted classes.

The procedures initially followed at UMKC were recommended to other participating institutions. Due to differing administrative structures of the many schools participating in the study, not all were able to gather data in precisely the recommended fashion. However, all reported their data gathering procedures, and evaluators determined that data gathering procedures of institutions included in the larger studies were precise enough to meet reasonable standards.

Data Collection and Analysis

The UMKC National SI Director was in charge of all data collection and analysis. The Director was also responsible for the collection, analysis, writing, and distribution of periodic reports on the SI program's effectiveness.

Standard statistical methods were used in analysis of data. The level of significance was set at $p < .01$ when independent *t*-tests were employed to compare final course grades. A significance level of $p < .05$ was set when using chi-square tests for comparing the following three sets of data: the percentage of A and B final course grades, the percentage of D and F final course grades and withdrawals; and the rates of re-enrollment. The chi-square level of significance was set at $p < .01$ for the study of graduation rates.

Chi-square at .05 level of significance was used with nominal data to heighten the sensitivity of

measures. On the other hand, a .01 level of significance was used with interval data in order to enhance its specificity.

Results

Academic Achievement for UMKC Students

Since 1980, UMKC has offered SI in 190 courses at the undergraduate, graduate, and professional school level. An analysis of data on grades and withdrawal rates (Table 2) found that the SI participants at UMKC

-earned a significantly higher percentage of A & B final course grades,
-earned a significantly lower percentage of D & F final course grades and withdrawals,
-earned significantly higher mean final course grades than the non-SI participants.

Table 2
SI UMKC Data: 1980 to 1991 (N = 190 SI Courses; N = 7,845 SI Participants)

Year	SI Participation Status	SI Participation Percent/ Number	Number of SI Courses	Percent A & B*	Percent D, F & Withdrawal*	Final Course Grade**
1990-91	SI	34.1% (774)	18	53.4%	16.0%	2.61
	Non-SI			38.7%	31.2%	2.23
1989-90	SI	30.3% (753)	19	58.3%	16.7%	2.70
	Non-SI			41.9%	34.8%	2.29
1988-89	SI	29.9% (614)	17	63.2%	15.6%	2.81
	Non-SI			45.7%	28.9%	2.39
1987-88	SI	34.1% (775)	24	60.4%	13.7%	2.80
	Non-SI			43.8%	28.9%	2.39
1986-87	SI	44.3% (778)	19	56.3%	18.3%	2.65
	Non-SI			40.9%	34.1%	2.41
1985-86	SI	39.1% (584)	16	51.5%	18.7%	2.55
	Non-SI			41.2%	28.7%	2.34
1984-85	SI	42.6% (788)	17	59.7%	16.8%	2.83
	Non-SI			42.9%	25.4%	2.27
1983-84	SI	34.1% (765)	19	54.5%	17.3%	2.76
	Non-SI			39.5%	29.5%	2.24
1982-83	SI	43.1% (1,119)	19	52.2%	17.9%	2.51
	Non-SI			36.8%	28.2%	2.07
1981-82	SI	40.9% (329)	5	58.2%	20.9%	2.61
	Non-SI			38.5%	26.7%	2.09
1980-81	SI	32.2% (556)	17	50.1%	14.2%	2.56
	Non-SI			32.5%	33.1%	2.16

*Level of significance for differences: .05 using chi-square test. **Level of significance for differences: .01 using independent *t*-test.

Controlling for Motivation. To control for motivation level, all students were surveyed in the spring of 1991 on the first day of class concerning interest in SI. Students were asked to rate their motivation to attend SI on a five-point Likert scale (5=high; 1=low). Since the scheduled times for the SI sessions were not announced until the second class sessions of the semester, students were not aware of any time conflicts. Students who selected "4" or "5" were designated as "highly motivated." During the last class period of the semester another survey was given to all students in the class. Students who did not attend any SI sessions during the semester were asked to select one of the designated choices for not attending SI. If a student selected either time conflict with work or with another college class and had also indicated high motivation to attend SI on the first day SI survey, the student was assigned to the non-SI motivational control group.

Creation of the non-SI motivational control group permitted comparison across the three groups: SI participants, non-SI participants (motivational control), and non-SI participants (all others). The following differences were seen in the academic performance data in Table 3. Students using SI services

- *had entry data (high school class rank percentile, and college entrance test scores) comparable to data of the other groups;
- *had significantly higher average course grades compared to both non-SI groups ($p < .01$); and
- *had considerably fewer D and F grades and withdrawals than either of the non-SI groups ($p < .05$).

Table 3
Comparison of SI Students, Non-SI (Motivational Control) Students, and Non-SI (All Other) Students (N = 644)

Group	Percent A & B Final Course Grade *	Percent D, F & W Final Course Grade *	Final Course Grade **
SI Students ($n = 209$)	44.5%	16.7%	2.45
Non-SI Students (Motivational control) ($n = 194$)	34.5%	34.5%	2.13
Non-SI Students (All Other) ($n = 241$)	26.3%	51.1%	1.90

*Level of significance of difference: .05 using chi-square test. **Level of significance of difference: .01 using independent *t*-test.

While it is clear that the more highly motivated perform at higher levels than the less motivated, motivation alone does not account for the majority of the differences between the SI and non-SI students with respect to the measures investigated. There are significant and substantial differences between the SI group and the motivational control group in both course grade and percent of unsuccessful enrollments.

Academic Achievement for Students from All Institutions Participating in SI

Nearly 100 colleges and universities submit data reports annually on their SI programs. The following table was compiled from data submitted by 49 institutions. These institutions were selected for analysis because they represent a cross-section of different institutional types, have rigorous data collection procedures, and transmit their data in a timely fashion. Table 4 provides findings from these 49 institutions. These findings are similar to those drawn from the UMKC campus alone.

Table 4
National Field Data (1982 - 1991) for SI Courses (N = 1,477)

Group	All Institutions (n = 1,477)		Two Year Public (n = 126)		Four Year Public (n = 1,071)		Four Year Private (n = 267)	
	Percent D,F, or W	Course Grade	Percent D,F, or W	Course Grade	Percent D, F, or W	Course Grade	Percent D,F, or W	Course Grade
SI	23%*	2.46**	24%*	2.64**	23%*	2.37**	19%*	2.54**
Non-SI	38%*	2.12**	41%*	2.31**	35%*	2.07**	32%*	2.27**

*Level of significance of difference: .05 using chi-square test. **Level of significance of difference: .01 using independent t-test.

Increased Rates of Persistence and Graduation

Ongoing research at UMKC indicates that students who participate in SI persist at the institution and graduate at higher rates than students who do not participate. Tables 5 and 6 provide information from UMKC comparing re-enrollment and graduation rates of SI participants and non-participants.

Table 5
Re-enrollment Rates of UMKC Students Enrolled in SI Courses, Fall 1989 (N = 1,689)

Group	Re-enrollment, Spring 1990
SI Students (n = 479)	90.0%*
Non-SI Students (n = 1,210)	81.5%*

*Level of significance of difference: .05 using chi-square test.

Table 6
Cumulative Graduation Rates of Fall 1983 UMKC First-Time, First-Year Students (N = 349)

	By Summer 1987	By Summer 1988	By Summer 1989	By Fall 1989
SI Students (n = 124)	19.4%**	25.8%**	28.2%**	30.6%**
Non-SI Students (n = 225)	9.3%**	15.1%**	17.8%**	18.2%**

**Level of significance of difference: .01 using chi-square test. Includes all students who were not enrolled in professional degree programs.

Effectiveness with Students of Differing Academic Preparation

Despite prior academic achievement, students participating in SI within targeted high-risk courses succeed at a higher rate than those who do not participate in SI. Data were analyzed to determine the utilization and effectiveness of SI services for students at UMKC with differing previous academic achievement (Table 7). Previous academic achievement was defined by high school (percentile) rank and mean composite score on the ACT entrance examination. Students were

Table 7
Comparison of SI Participants and Non-Participants at UMKC with Differing Levels of Previous Academic Achievement: 1989 - 1990 Academic Year (N = 1,628)

Group Composition	Percentage of Students in Targeted Classes	High School Percentile Rank	Mean Composite ACT Score	Percent Re-enrolled Following Semester	Final Course Grade
Top Quartile SI (n = 112)	32.9%	87.5	26.8	92.9%	3.29**
Top Quartile, Non-SI (n = 288)	67.1%	82.1	27.0	93.1%	2.83**
Middle Two Quartiles SI (n = 262)	27.6%	68.7	21.3	90.5%*	2.67**
Middle Two Quartiles Non-SI (n = 687)	72.4%	67.7	21.4	77.9%*	2.28**
Bottom Quartile SI (n = 104)	30.7%	64.9	15.1	85.6%*	2.10**
Bottom Quartile Non-SI (n = 235)	69.3%	63.5	15.7	77.9%*	1.77**

*Level of significance of difference: .05 using chi-square test. **Level of significance of difference: .01 using independent t-test.

divided into quartiles on the basis of their mean composite ACT score as compared with other UMKC students.

The data in Table 7 warrant the following observations. Students in the bottom quartile used SI services at nearly the same rate as did students in the top quartile. Despite quartile ranking, SI-participating students earned significantly higher grades than their non-participating counterparts. SI participating students in the bottom quartile and the middle two quartiles re-enrolled at the institution at significantly higher rates than their non-participating counterparts. While the SI and non-SI groups in the top quartile re-enrolled at 93%, the top quartile SI participants received a significantly higher mean final course grade.

SI services appear to meet the needs of students with a wide range of previous levels of academic achievement within the same group setting, thus reducing the necessity for the institution to provide additional and separate tutorial programs.

Effectiveness with Minority Students

Irrespective of ethnicity, students participating in SI within targeted high-risk courses succeed at a higher rate (withdraw at lower rates, receive a lower percentage of D or F final grades, and earn higher average final grades) than those who do not participate in SI. In a recent study of 2,410 students at 13 colleges and universities, minority students who participated in SI earned higher final course grades than their non-participating peers. These institutions were selected because they had numerous SI sections in place, had sufficiently rigorous data collection procedures, and had transmitted their data in a timely fashion. The 13 institutions represent a cross-section of institutional types (3 two-year public colleges; 4 four-year private colleges and universities, and 6 four-year public colleges and universities). The following data were provided for each student in the study: race, standardized entry test scores, number of times attending SI, and final course grade. As the data in Table 8 indicate, whether the minority students were from the top or bottom quartile of their ACT test score group, the SI participants received a lower percentage of D and F final course grades and withdrawals than their non-participating counterparts.

Table 8
Effectiveness of SI for Minority Students with Differing Levels of Previous Academic Achievement (N = 299)

Group Composition	Percent D, F, & W		Mean Final Course Grade	
	SI	Non-SI	SI	Non-SI
All Students	36%*	43%*	2.02**	1.55**
Lowest Quartile	Not Collected	Not Collected	1.87**	1.35**
Highest Quartile	Not Collected	Not Collected	2.64**	1.97**

*Level of significance of difference: .05 using chi-square test. **Level of significance of difference: .01 using independent *t*-test.

The data in Table 9 reveal that minority students used SI services at equal or higher rates than Caucasian students.

Table 9
1987 SI Participation of Students from Different Ethnic Groups (N = 2,410)

Caucasian (n = 2,111)	African-American (n = 174)	Hispanic (n = 55)	Asian/Pacific (n = 42)	Native American (n = 28)
33.8%	42.0%	50.9%	33.3%	42.9%

An additional study was undertaken at UMKC to determine the effectiveness of SI participation on the academic performance of 100 African-American students who were enrolled in 12 courses in the College of Arts and Science, School of Pharmacy, and School of Basic Life Science in Fall 1987. Data in Table 10 suggest that the 39 African-American students participating in SI earned a statistically significant higher mean final course grade and a lower percentage of Ds and Fs than the 71 students who did not participate.

Table 10
Effectiveness of SI with UMKC African-American Students (N = 110)

Group	Number/Percentage Students	Percent D, F, or W	Mean Final Course Grade
SI-Students	39 (35.5%)	31%*	2.20**
Non-SI Students	71 (64.5%)	46%*	1.80**

*Level of significance of difference: .05 using chi square test. **Level of significance of difference: .01 using independent *t*-test.

Validation of Supplemental Instruction by the U.S. Department of Education

In 1981, after a rigorous review process, the SI program became one of the few postsecondary programs to be designated by the U.S. Department of Education as an Exemplary Educational Program. The SI program was recertified in 1985 and 1992. The U.S. Department of Education has validated the following three claims of effectiveness of the SI Program:

1. Students participating in SI within the targeted high-risk courses *earn higher mean final course grades* than students who do not participate in SI. This is still true when analysis controls for ethnicity and prior academic achievement.

2. Despite ethnicity and prior academic achievement, students participating in SI within targeted high-risk courses *succeed at a higher rate* (withdraw at a lower rate and receive a lower percentage of D or F final course grades) than those who do not participate in SI.

3. Students participating in SI *persist at the institution* (re-enroll and graduate) at higher rates than students who do not participate in SI.